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L24: Entry 154 of 166

File: USPT

Jul 8, 1997

DOCUMENT-IDENTIFIER: US 5645702 A

TITLE: Low voltage miniaturized column analytical apparatus and method

Detailed Description Text (14):

Referring to FIG. 5, the separation compartment 8 has a medium through which dissolved, charged particles can propagate. Using liquid media, it is preferred to apply a surface treatment of the channel so as to eliminate irreversible adsorption of solutes to the substrate material. "Surface treatments" as used herein refer to preparation or modification of the surface of a microchannel which will be in contact with a sample during separation, whereby the separation characteristics of the device are altered or otherwise enhanced. Such treatments can include: physical surface adsorptions; covalent bonding of selected moieties to functional groups on the surface of microchannel substrates (such as to amine, hydroxyl or carboxylic acid groups on condensation polymers); methods of coating surfaces, including dynamic deactivation of channel surfaces (such as by adding surfactants to media), polymer grafting to the surface of channel substrates (such as polystyrene or divinyl-benzene) and thin-film deposition of materials such as diamond or sapphire to microchannel substrates. Such treatment techniques are known in the art. Additionally, the separation compartment may be filled with an anticonvective medium such as beads, gel, and the like.

Detailed Description Text (43):

Substrates such as polymers, glass, silicon, silicon dioxide, quartz, ceramics, and the like are contemplated as suitable substrates in the present invention. Metals such as copper, silver, aluminum, nickel, and other metals commonly used for electrical conductors can be used for the electrical components such as antennas and electrical connectors.

Detailed Description Text (49):

The term "LIGA process" is used to refer to a process for fabricating microstructures having high aspect ratios and increased structural precision using synchrotron radiation lithography, galvanofarming, and plastic molding. Under a LIGA process, radiation sensitive plastics are lithographically irradiated at high energy radiation using a synchrotron source to create desired microstructures (such as channels, ports, apertures and micro-alignment means), thereby forming a primary template. The primary template is then filled with a metal by electrodeposition techniques. The metal structure thus formed comprises a mold insert for the fabrication of secondary plastic templates which take the place of the primary template. In this manner highly accurate replicas of the original microstructures may be formed in a variety of substrates using injection or reactive injection molding techniques. The LIGA process has been described by Becker, E. W., et al., Microelectric Engineering 4 (1986) pp. 35-56. Descriptions of numerous polymer substrates which may be injection molded using LIGA templates, and which are suitable substrates in the practice of the subject invention, may be found in "Contemporary Polymer Chemistry", Allcock, H. R. and Lampe, F. W. (Prentice-Hall, Inc.) New Jersey (1981).

Detailed Description Text (54):

The term "substrate" is used herein to refer to any material which is processed to have microstructures and electrical components formed thereon. Although, in the following illustrative description, microstructures are formed on a polymeric substrate, laser ablation can be used for forming similar structures in ceramics (including aluminum oxides and the like), silicon containing materials (e.g., silicon, glass, silicon dioxide), and the like.

Detailed Description Text (55):

In general, any substrate which is laser light (e.g., UV) absorbing provides a suitable substrate in which one may laser ablate features. Accordingly, under the present invention, microstructures of selected configurations can be formed by imaging a

lithographic mask onto a suitable substrate, such as a polymer or ceramic material, and then laser ablating the substrate with laser light in areas that are unprotected by the lithographic mask.

Detailed Description Text (59):

In the practice of the invention, a preferred substrate comprises a polyimide material such as those available under the trademarks KAPTON or UPILEX from DuPont (Wilmington, Del.), although the particular substrate selected may comprise any other suitable polymer or ceramic substrate. Polymer materials particularly contemplated herein include materials selected from the following classes: polyimide, polycarbonate, polyester, polyamide, polyether, polyolefin, or mixtures thereof. Further, the polymer material selected may be produced in long strips on a reel, and, optional sprocket holes along the sides of the material may be provided to accurately and securely transport the substrate through a step-and-repeat process.

Detailed Description Text (67):

Generally, miniaturized column 102 is formed in a selected substrate 104 using laser ablation techniques. The substrate 104 generally comprises first and second substantially planar opposing surfaces indicated at 106 and 108 respectively, and is selected from a laser light material. As previously stated, examples of suitable substrates include ceramics and polymers such as (but are not limited to) polyimides, polyamides, polyesters, and polycarbonates.

Current US Cross Reference Classification (2):

204/600

Current US Cross Reference Classification (3):

204/601

CLAIMS:

13. The apparatus of claim 12 wherein the substrate is selected from the group consisting of polymeric material, ceramic materials, and combinations thereof.

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L24: Entry 153 of 166

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DOCUMENT-IDENTIFIER: US 5750015 A

TITLE: Method and device for moving molecules by the application of a plurality of electrical fields

Brief Summary Text (2):

This invention relates generally to the fields of electrophoresis and photolithography which is applied in a manner so as to integrate technological innovations in the fields of biochemistry, polymer science, molecular genetics and electronics. More specifically, the invention relates to a method of moving charged molecules or particles in a medium by the simultaneous or sequential application of a plurality of electrical fields and devices for carrying out that method, where the supporting substrate is a substantially uncharged organic polymeric substrate and the device allows for movement along a central trench and lateral trenches.

Brief Summary Text (17):

Yet another advantage of the present invention is the minimization or elimination of electroendosmosis by the utilization of polymeric substrates, such as polymethylmethacrylate.

Brief Summary Text (20):

Yet another advantage of the present invention is the use of inert polymeric substrate materials or components which might contact charged particles to be separated or combined which materials minimize protein absorption and loss of sample materials being separated and/or combined.

Detailed Description Text (10):

The Card 1 as well as the Trench 2 and electrode connections 4-10 can be readily and economically produced by standard microelectronic fabrication techniques. Accordingly, multiple copies of nearly identical cards can be readily reproduced with a high degree of accuracy. The fidelity and economy of production are important features of the invention. Since the substrate of the card is preferably a rigid polymeric material, particularly synthetic organic polymers or plastics, addition or condensation polymers, such as polymethylmethacrylate, polycarbonate, polyethylene terephthalate, polystyrene or styrene copolymers, the card itself does not have a surface charge. Accordingly, there is no (or negligible) surface charge in the Trench 2, and therefore the problem of electroendosmosis is alleviated. Electroendosmosis is a substantial problem in connection with high performance capillary electrophoresis techniques which utilize glass capillaries which generally must be coated with a polymer in order to suppress the electroendosmosis. The polymer material can be made substantially non-porous. Accordingly, the charged particles such as proteins are not absorbed and loss of sample during separation is minimal.

Current US Original Classification (1):204/454Current US Cross Reference Classification (1):204/451Current US Cross Reference Classification (3):204/601

## CLAIMS:

4. In a method for moving charged particles through a medium in a movement area comprising a trench of capillary dimensions using an electrical field with spaced apart electrodes positioned to be in electrical contact with a medium when present in said trench to produce said field, the improvement comprising:

supporting said medium with a non-porous polymer substrate having a substantially uncharged surface.

14. A device for moving charged particles through a medium employing an electrical field, said device comprising:

a polymer solid substrate having an upper surface, wherein said upper surface of said polymer solid substrate is substantially uncharged;

a main trench of capillary dimensions in said substrate having opposite ends;

a pair of electrodes positioned to be in electrical contact with a medium when present in said trench, with one electrode proximal to one end of said trench and the other electrode proximal to the other end of said trench;

means for connecting said electrodes to a source of electricity; and

means for introducing and removing liquid from said trench.

19. A device for moving charged particles through a medium employing an electrical field, said device comprising:

an organic polymer solid substrate having an upper surface, wherein said upper surface of said organic polymer is substantially uncharged;

a main trench in said substrate extending downward from said upper surface, having opposite ends, said trench having a depth of about 5 and 25. $\mu$ m. and extending across said substrate;

a pair of electrodes positioned to be in electrical contact with a medium when present in said trench, with one electrode proximal to one end of said trench and the other electrode proximal to the other end of said trench;

means for connecting said electrodes to a source of electricity; and

ports for liquid transfer proximal to each end of said trench for liquid transport or a reservoir at each end of said trench.

20. A device according to claim 19, wherein said organic polymer substrate is polymethylmethacrylate.

31. A device for moving charged particles through a medium employing an electrical field, said device comprising:

an organic polymer solid substrate having an upper surface, wherein said upper surface of said organic polymer solid substrate is substantially uncharged;

a main trench in said substrate extending downward from said upper surface having opposite ends, said trench having capillary dimensions and extending across said substrate;

a pair of electrodes positioned to be in electrical contact with a medium when present in said main trench, with one electrode proximal to one end of said main trench and the other electrode proximal to the other end of said main trench;

at least one lateral branch trench crossing said main trench, wherein said at least one lateral branch trench comprises a charged reactant material;

at least one additional pair of electrodes positioned to be in electrical contact with a medium when present in said lateral branch trench, each additional pair proximal to opposite ends of each of said lateral branch trenches;

means for connecting said electrodes to a source of electricity; and

ports for liquid transfer proximal to each end of said trench for liquid transport or a reservoir at each end of said trench.

41. A device for moving particles through a medium employing an electrical field, said

device comprising:

a non-porous polymer substrate having an upper surface;

a main trench in said substrate extending downward from said upper surface having opposite ends, said trench having capillary dimensions and extending across said substrate;

a pair of electrodes positioned to be in electrical contact with a medium when present in said main trench, with one electrode proximal to one end of said main trench and the other electrode proximal to the other end of said main trench;

at least two branch trenches connected to said main trench;

at least one electrode positioned in each of said branch trenches so as to be in electrical contact with a medium present in said branch trenches;

means for connecting said electrodes to a source of electricity; and

ports for liquid transfer proximal to each end of said trench for liquid transport or a reservoir at each end of said trench.